

1 This application is a continuation-in-part of U.S. patent application No.
2 09/770,848, filed January 26, 2001, which is a continuation of U.S. patent application No.
3 08/862,201 filed May 23, 1997, now U.S. Patent No. 6,218,342 which is a non-
4 provisional that claims the benefit of Provisional Application No. 60/023,043 filed
5 August 2, 1996.

6 BACKGROUND OF THE INVENTION

7 Many types of fluids have been used in the drilling of oil and gas wells. The
8 selection of an oil-based drilling fluid, also known as oil-based mud, involves a careful
9 balance of the both the good and bad characteristics of such fluids in a particular
10 application, the type of well to be drilled and the characteristics of the oil or gas field in
11 which the well is to be drilled. A surfactant capable of emulsifying incorporated water
12 into the oil is an essential component of oil-based muds.

13 The primary benefits of selecting an oil-based drilling fluid include: superior hole
14 stability, especially in shale formations; formation of a thinner filter cake than the filter
15 cake achieved with a water based mud; excellent lubrication of the drilling string and
16 downhole tools; penetration of salt beds without sloughing or enlargement of the hole as
17 well as other benefits that should be known to one of skill in the art.

An especially beneficial property of oil-based muds is their excellent lubrication qualities. These lubrication properties permit the drilling of wells having a significant vertical deviation, as is typical of off-shore or deep water drilling operations or when a horizontal well is desired. In such highly deviated holes, torque and drag on the drill string are a significant problem because the drill pipe lies against the low side of the hole, and the risk of pipe sticking is high when water based muds are used. In contrast oil-based muds provide a thin, slick filter cake which helps to prevent pipe sticking and thus the use of the oil based mud can be justified.

Despite the many benefits of utilizing oil-based muds, they have disadvantages. In general the use of oil based drilling fluids and muds has high initial and operational costs. These costs can be significant depending on the depth of the hole to be drilled. However, often the higher costs can be justified if the oil based drilling fluid prevents the caving in or hole enlargement which can greatly increase drilling time and costs. Disposal